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Guidelines for Decontaminating Buildings Structures, and Equipment at Superfund Sites

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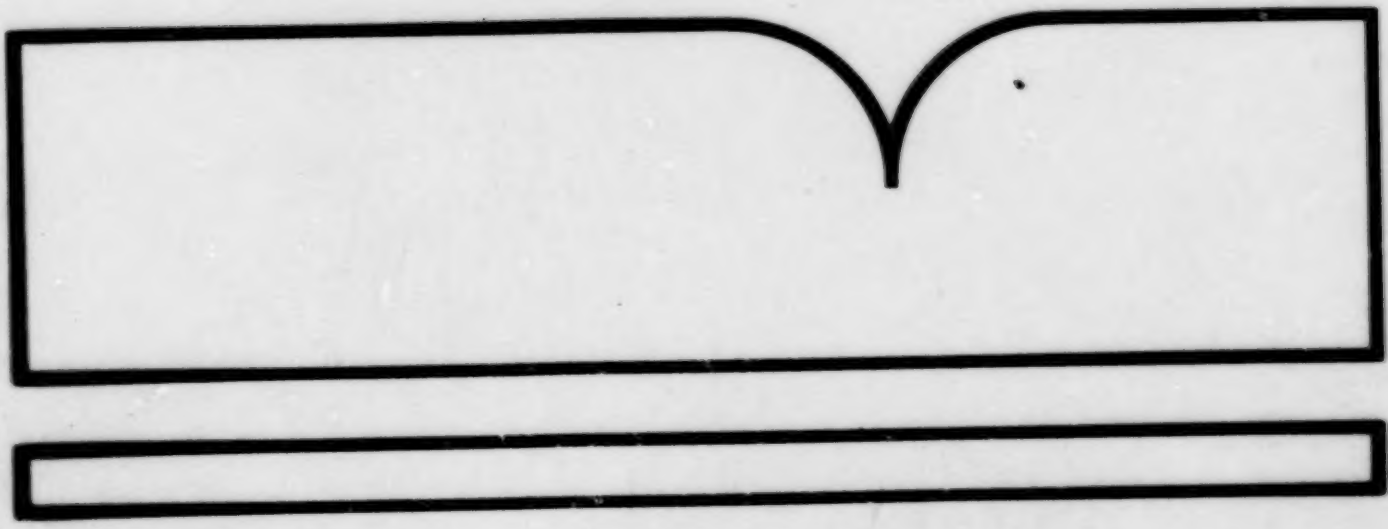

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16. ABSTRACT

This paper identifies contaminants most likely to occur in buildings and structures or on removal equipment at remedial sites. Steps for developing a general decontamination strategy are enumerated. The paper also announces a User's Guide or handbook that will be published by the U.S. EPA as the final product of Contract 68-03-3190.

Additional research needs concerning building decontamination are identified and the need for documentation and verification of methods currently in use is stressed.

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GUIDELINES FOR DECONTAMINATING BUILDINGS, STRUCTURES, AND EQUIPMENT AT SUPERFUND SITES

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PURPOSE OF STUDY

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Superfund legislation, established a dual-phase program for responding to environmental problems caused by hazardous substances. The "removal program" involves cleanup or other actions that are taken in response to emergency conditions, or on a short-term or temporary basis. The "remedial program" involves response actions that tend to be long-term in nature and that permanently remedy problem sites.

To be eligible for cleanup under Superfund, a site must be included on the National Priorities List (NPL). As of this writing, 406 sites appear on the NPL, which was promulgated by the U.S. Environmental Protection Agency (EPA) on September 8, 1983. Currently, the EPA is proposing the addition of 133 new sites to the list.

As the number of sites on the NPL grows and as removal and remedial activities at Superfund sites accelerate, the task of decontaminating buildings, structures, and construction equipment will become increasingly important. These items often represent large capital

investments, and the costs of dismantling and disposing of such structures in a secure landfill can be very expensive. The objective of an effective decontamination program, therefore, is to return contaminated buildings, structures, and equipment to active, productive status.

This study had as its goal the development of a general guide for government personnel, cleanup contractors, and other individuals responsible for planning and executing decontamination activities at Superfund sites.

TECHNICAL APPROACH

As an initial part of the study (begun in the fall, 1983), a survey of ongoing decontamination activities at 50 Superfund sites across the country, which were thought to have potentially contaminated buildings, structures, and equipment, was conducted in order to gather information on 1) the types of contaminants of most concern and 2) the methods currently being proposed or used for decontamination of the buildings, structures, and equipment in place at these sites. Contractors and numerous other individuals with direct experience in both Superfund and non-Superfund related programs involving decontamination of dioxins, explosives, PCB's, and other toxic wastes from buildings and equipment were contacted. In addition, a thorough search of published literature for information on decontamination methods was conducted through computerized search services.

From these surveys, a decontamination data base containing state-of-the-art information on specific cleanup methods and their applications, as well as guidelines for developing site-specific cleanup strategies, was developed.

RESULTS

The 1983 survey of building/equipment decontamination practices at Superfund sites revealed that the contaminants of most concern at these sites include asbestos, acids and alkalis, dioxins, explosives, heavy metals, cyanides, low-level ionizing radiation, organic solvents, pesticides, and PCB's. The methods used to remove these substances from buildings, structures, and equipment are few in number and rarely documented in detail. For example, it is common practice to steam clean equipment such as backhoes, bulldozers, and drilling augers, but testing to verify that the contaminants of concern have been adequately removed is generally not performed. Contaminated buildings and structures are seldom cleaned and returned to active use. More often, they are closed and barricaded to prevent further entry and exposure until sometime in the future when a solution regarding their disposition can be found. Some buildings are torn down and buried in landfills. Contaminated underground structures such as tanks, sumps, and sewers are sometimes filled in place with concrete to prevent their reuse.

Because these findings clearly pointed to the need for basic guidance material on decontamination methods, the remainder of the project was devoted to developing a manual, or user's guide, for this purpose. The handbook which was developed presents general guidelines for developing a rationale and strategy (summarized in Figure 1) for dealing with the prospect of decontamination, including guidance and information for selecting the least-costly method(s) that are technologically feasible and that will effectively reduce contamination to predetermined levels. Steps in the process include 1) determining the nature and extent of contamination, 2) developing and implementing a

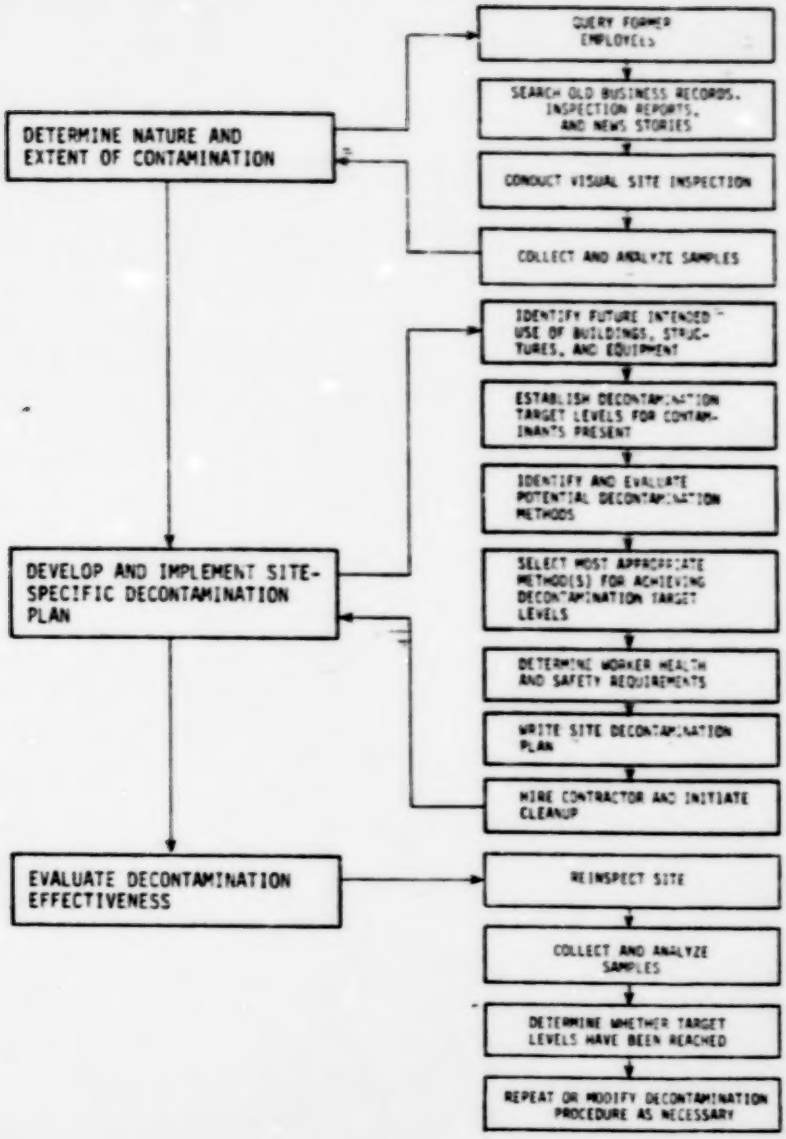
DETERMINE NATURE AND EXTENT OF CONTAMINATION
QUERY FORMER EMPLOYEES
SEARCH OLD BUSINESS RECORDS, INSPECTION REPORTS, AND NEWS STORIES
CONDUCT VISUAL SITE INSPECTION
COLLECT AND ANALYZE SAMPLES
DEVELOP AND IMPLEMENT SITE-SPECIFIC DECONTAMINATION PLAN
IDENTIFY FUTURE INTENDED USE OF BUILDINGS, STRUCTURES, AND EQUIPMENT
ESTABLISH DECONTAMINATION TARGET LEVELS FOR CONTAMINANTS PRESENT
IDENTIFY AND EVALUATE POTENTIAL DECONTAMINATION METHODS
SELECT MOST APPROPRIATE METHOD(S) FOR ACHIEVING DECONTAMINATION TARGET LEVELS
DETERMINE WORKER HEALTH AND SAFETY REQUIREMENTS
WRITE SITE DECONTAMINATION PLAN
HIRE CONTRACTOR AND INITIATE CLEANUP
EVALUATE DECONTAMINATION EFFECTIVENESS
REINSPECT SITE
COLLECT AND ANALYZE SAMPLES
DETERMINE WHETHER TARGET LEVELS HAVE BEEN REACHED
REPEAT OR MODIFY DECONTAMINATION PROCEDURE AS NECESSARY

Figure 1. Flow diagram illustrating sequence of steps for developing a decontamination strategy.

site-specific decontamination plan, and 3) evaluating decontamination effectiveness. Step 1 consists of a) querying former employees, b) searching old business reocrds, inspection reports, and news stories c) conducting a visual site inspection, and d) collecting and analyzing samples from the contaminated surfaces or structures. Step 2 is further broken down into the following activities: a) identifying the future intended use of buildings, structures, and equipment; b) establishing decontamination target levels for the contaminants present; c) identifying and evaluating potential decontamination methods; d) selecting the most appropriate method(s) for achieving the decontamination target levels; e) determining worker health and safety requirements (training, medical surveillance, personal protective equipment, site safety); f) writing the site decontamination plan; g) estimating costs; and h) hiring the contractor and initiating cleanup. Step 3 involves a) reinspecting the site for evidence of residual contamination, b) collecting and analyzing samples from the decontaminated area, and c) determining whether the target levels for residual contamination have been reached. This step can also include repeating, and if necessary, modifying the decontamination procedures until satisfactory results are obtained. Descriptions of actual building decontamination efforts at both Superfund and non-Superfund sites are included as case studies.

The manual contains process descriptions for 21 decontamination methodologies including both traditional and developmental techniques (asbestos abatement, absorption, demolition, dismantling, dusting/vacuuming/wiping, encapsulation, gritblasting, hydroblasting/water-washing, painting/coating, scarification, RadKleen, solvent washing,

steam cleaning, vapor-phase solvent extraction, acid etching, bleaching, flaming, drilling and spalling, K-20, microbial degradation, and photochemical degradation), and describes their potential applicability to various combinations of contaminants and materials. Potential cleanup methods are identified in a two-dimensional matrix (see Table 1) matching contaminants (asbestos, acids, alkalis, dioxins, explosives, heavy metals and cyanides, low-level radiation, organic solvents, pesticides, PCB's, and all contaminants in liquid form) with materials/surfaces (all wall, ceiling, and floor surfaces; glass; plastic; metal; wood; brick; concrete; aluminum; and equipment and auxiliary structures). Finally, the manual describes safeguards for protecting the health and safety of decontamination workers during site operations. Topics covered include personnel training, medical surveillance, personal protective equipment, and site safety.

CONCLUSIONS AND RECOMMENDATIONS FOR ADDITIONAL RESEARCH

As a result of this paper study, it has become clear that all future owners of decontaminated buildings and structures on Superfund sites should be advised of the nature of the contamination that was present, the cleanup methods used, and levels of any residual contaminants. Ensuring the transfer of such information from one site owner to the next will require a method for permanently recording this information. Regulations requiring the addition of such information to the property deed, as is required in the deed of all RCRA-permitted facilities, may be a workable solution.

The handbook which was developed will provide much of the guidance needed by site cleanup personnel for decontaminating buildings,

TABLE 1. POTENTIAL DECONTAMINATION METHODS FOR VARIOUS CONTAMINANT/MATERIAL COMBINATIONS[a]

Material/surface	Contaminant										
	Asbestos	Acids	Alkalis	Dioxins	Explosives	Heavy metals and cyanide	Low-level radiation	Organic solvents	Pesticides	PCB's	All contaminants in liquid form
All wall, ceiling, and floor surfaces	1,3,4,5	3,4,6,9, 16	3,4,6,9	3,4,5,6,9, 21	3,4,6,9,13	3,4,5,6,8, 9,16	3,4,5,6,9	3,4,6,9	3,4,6,9,13	3,4,5,6,9	2
Glass	1,3,4,5	3,4,6,9,16	3,4,6,9	3,4,5,6,9,21	8,16	3,4,5,6,8,9,16	8	3,4,6,9	16	3,4,5,6,9	2
Plastic	1,3,4,5	3,4,6,9,16	15	15	8,15,16	15	8,15	15	15,16	15	2
Metal	1,3,4,5	7	7,15	7,15	7,8,15,16, 17	7,15	7,8,15	7,15	7,15,16	7,15	2
Wood	1,3,4,5	7	7,15	7,15	7,15,16,20	7,15	7,15	7,15	7,15,16,20	7,15,19	2
Brick	1,3,4,5	7	7,15	7,15	7,8,15,17, 20	7,15	7,8,15	7,15	7,15,20	7,15,19	2
Concrete	1,3,4,5	7,10,18	7,10,15,18	7,10,15,18	7,8,10,15, 16,17,18, 20	7,10,15,18	5,7,8,10, 15,17,18	7,10,15,18	7,10,15,16 18,20	7,10,15,18, 19	2
Equipment and auxiliary structures (bulldozers, electrical transformers and capacitors, sumps, ventilation ducts, etc.)	1,5	4,6,11,12 13	4,6,11,12 13	4,5,6,11, 12,13,21	4,6,8,11, 12,13,17	4,5,6,7,8, 11,12,13	4,6,8,11, 12,13	4,6,11, 12,13	4,6,11, 12,13	4,5,6,11, 12,13,14	2

Key for decontamination methods:

1. Asbestos abatement
2. Absorption
3. Demolition
4. Dismantling
5. Dusting/vacuuming/wiping
6. Encapsulation
7. Abrasive gritblasting
8. Hydroblasting/waterwashing
9. Painting/coating
10. Scarification
11. Radkleen
12. Solvent washing
13. Steam cleaning
14. Vapor-phase solvent extraction
15. Acid etching
16. Bleaching
17. Flaming
18. Drilling and spalling
19. K-20 coating
20. Microbial degradation
21. Photochemical degradation

[a] Each cell in the matrix represents a specific contaminant/substrate combination and contains numbers corresponding to decontamination methods that either have been used in the specific interactions, or have the potential for such use, based on available information in the published literature. Each methodology can be used alone or in conjunction with one or more of the other procedures.

structures, and equipment. However, additional research is needed to bridge gaps in the state of the art in four key information areas. First, and perhaps most importantly, sampling methods for determining the type and degree of contamination existing on building/structure/equipment surfaces, both before and after cleanup efforts, are poorly developed, documented, and verified. Similarly, subsurface sampling techniques (such as corings) for determining the depth of contamination in porous substances (such as concrete or wood floors) have not been adequately developed and documented. Although "wipe tests" are often referred to in site records, the actual methodology used is rarely described in enough detail to allow simulation or reproduction by others, and the technique itself is known to be inadequate for quantitatively transferring contaminants from surfaces to wipes or swabs. Additional research in this area is badly needed.

Second, many of the decontamination techniques described in the manual were developed specifically by the U.S. Army's Installation Restoration Program. Their applicability to contaminant/material combinations encountered at Superfund sites has not been fully explored. Even where decontamination techniques are indicated for certain contaminant/material combinations, the more detailed methodology descriptions should be consulted for any future work that may be required before the methods are selected.

Third, the effectiveness of many decontamination methods currently in use has not been verified and documented. For example, the degree to which steam cleaning removes dioxin-contaminated soil particles from drilling augers has not been established. Decontamination

methods that have not previously been applied to specific contaminant/substrate combinations but show a strong potential applicability should be validated in pilot investigations. Additions/deletions to the matrix should be made accordingly. New decontamination technologies that become available also should be evaluated and added to the matrix.

Fourth, a formal, systematic approach for determining acceptable levels of contaminants remaining in and on building and equipment surfaces does not currently exist. As a result, guidance on the "how clean is clean?" issue and the establishment of target levels could not be included in this manual and must continue to be addressed on a case-by-case basis.

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